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Please find below and/or attached an Office communication concerning this application or proceeding.

5

Office Action Summary

Application No.

10/688,420

Applicant(s)

KLOCKE ET AL.

Examiner

Edna Wong

Art Unit

1753

– The MAILING DATE of this communication appears on the cover sheet with the correspondence address –
 Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 January 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-69 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-69 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>January 27, 2006</u> . | 6) <input type="checkbox"/> Other: _____ |

This is in response to the Amendment dated January 27, 2006. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Response to Arguments

Specification

The disclosure has been objected to because of minor informalities.

The objection of the disclosure has been withdrawn in view of Applicants' amendment.

Claim Objections

Claims **1-2, 28 and 31** have been objected to because of minor informalities.

The objection of claims 1-2, 28 and 31 has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 112

I. Claims **63-65** have been rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for electrodepositing, does not reasonably provide enablement for electrolessly depositing. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

The rejection of claims 63-65 under 35 U.S.C. 112, first paragraph, is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the following reasons:

Claim 63, lines 4-7, recite "depositing copper". This method step still reads on electrolessly depositing the copper.

Furthermore, the preamble of claim 63, line 1, as current amended, now recites "A method for electrolytically plating a workpiece". The body of the claim, however, does not recite any electrolytically plating step. Thus, the body of the claim does not recite and electrolytically plating method.

II. Claims 5, 9, 12-13, 20-21, 24, 28, 30-32, 37, 41, 46, 50, 57, 61, 64-65 and 67 have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With regards to claims 5, 9, 12-13, 20, 28, 31-32, 57 and 61, the rejection under 35 U.S.C. 112, second paragraph, has been withdrawn view of Applicants' amendment.

With regards to claims 21, 24, 30, 37, 41, 46, 50, 64-65 and 67, the rejection under 35 U.S.C. 112, second paragraph, is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the following reasons:

Claim 21

The composition already comprises a copper-deposition accelerator (from claim 19, line 5). However, it is still unclear if the composition further comprises an additional copper-deposition accelerator present at a concentration of from about 2 to about 8 ml/L because, then, the electroplating composition would contain two copper-deposition accelerators.

Claim 21, lines 1-2, as presently written, reads on that the copper-deposition accelerator present at a concentration of from about 2 to about 8 ml/L is not the same as the copper-deposition accelerator recited in claim 19, line 5.

Claim 30

The composition already comprises a copper-deposition accelerator (from claim 26, line 5). However, it is still unclear if the composition further comprises an additional copper-deposition accelerator present at a concentration of from about 2 to about 30 ml/L because, then, the electroplating composition would contain two copper-deposition accelerators.

Claim 30, lines 1-2, as presently written, reads on that the copper-deposition accelerator present at a concentration of from about 2 to about 30 ml/L is not the same as the copper-deposition accelerator recited in claim 26, line 5.

Claim 37

The composition already comprises a copper-deposition accelerator (from claim 35, line 6). However, it is still unclear if the composition further comprises an additional copper-deposition accelerator present at a concentration of from about 2 to about 30 ml/L because, then, the electroplating composition would contain two copper-deposition accelerators.

Claim 37, lines 1-2, as presently written, reads on that the copper-deposition accelerator present at a concentration of from about 2 to about 30 ml/L is not the same as the copper-deposition accelerator recited in claim 35, line 6.

Claim 41

The composition already comprises a copper-deposition accelerator (from claim 35, line 6). However, it is still unclear if the composition further comprises an additional copper-deposition accelerator present at a concentration of from about 2 to about 8 ml/L because, then, the electroplating composition would contain two copper-deposition accelerators.

Claim 41, lines 1-2, as presently written, reads on that the copper-deposition accelerator present at a concentration of from about 2 to about 8 ml/L is not the same as the copper-deposition accelerator recited in claim 35, line 6.

Claim 46

The composition already comprises a copper-deposition accelerator (from claim 44, line 5). However, it is still unclear if the composition further comprises an additional copper-deposition accelerator present at a concentration of from about 2 to about 30 ml/L because, then, the electroplating composition would contain two copper-deposition accelerators.

Claim 46, lines 1-2, as presently written, reads on that the copper-deposition accelerator present at a concentration of from about 2 to about 30 ml/L is not the same as the copper-deposition accelerator recited in claim 44, line 5.

Claim 50

The composition already comprises a copper-deposition accelerator (from claim 44, line 5). However, it is still unclear if the composition further comprises an additional copper-deposition accelerator present at a concentration of from about 2 to about 8 ml/L because, then, the electroplating composition would contain two copper-deposition accelerators.

Claim 50, lines 1-2, as presently written, reads on that the copper-deposition accelerator present at a concentration of from about 2 to about 8 ml/L is not the same as the copper-deposition accelerator recited in claim 44, line 5.

Claim 64

The composition already comprises from about 2 to about 30 ml/L copper-deposition suppressor and from about 2 to about 30 ml/L copper-deposition accelerator (from claim 63, lines 6-7). However, it is still unclear if the composition further comprises an additional copper-deposition suppressor and copper-deposition accelerator because, then, the electroplating composition would contain two copper-deposition suppressors and two copper-deposition accelerators.

Claim 64, lines 3-4, as presently written, reads on that the copper-deposition suppressor and the copper-deposition accelerator are not the same as the copper-deposition suppressor and copper-deposition accelerator recited in claim 63, lines 6-7.

Claim 65

The composition already comprises from about 2 to about 30 ml/L copper-deposition suppressor and from about 2 to about 30 ml/L copper-deposition accelerator (from claim 63, lines 6-7). However, it is still unclear if the composition further comprises an additional copper-deposition suppressor and copper-deposition accelerator because, then, the electroplating composition would contain two copper-deposition suppressors and two copper-deposition accelerators.

Claim 65, lines 3-4, as presently written, reads on that the copper-deposition suppressor and the copper-deposition accelerator are not the same as the copper-deposition suppressor and copper-deposition accelerator recited in claim 63, lines 6-7.

Claim 67

The composition already comprises a glycol-based suppressor (from claim 66, line 12). However, it is still unclear if the composition further comprises an additional from about 2 to about 30 ml/L of a copper-deposition suppressor because, then, the electroplating composition would contain two suppressors.

Claim 67, line 3, as presently written, reads on that the copper-deposition suppressor is not the same as the glycol-based suppressor recited in claim 66, line 12.

Claim Rejections - 35 USC § 103

I. Claims 1-5 have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 1-5 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 in combination with Reid '857 is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the following reasons:

Applicants state that not only are there reported surprising and unexpected results with the current Applicants' claimed compositions, but the '796 patent essentially teaches away from using the claim 1 recited copper and acid concentrations ranges. It is clear that the '796 patent does not teach or suggest any compositions comprising the relatively narrow ranges recited in claim 1 of the present application.

In response, a prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. *W.L. Gore & Associates, Inc. V. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. Denied*, 469 U.S. 851 (1984). In addition, a known or obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use, see *In re Gurley*, 27 F.3d 551, 554, 31 USPQ2d 1130, 1132 (Fed. Cir. 1994). Further, a reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill in the art, including nonpreferred embodiments, see *Merck & Co. v. Biocraft Laboratories*, 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), *cert. denied*, 493 U.S. 975 (1989). See MPEP § 2141.02, MPEP 2145X.D.1 and MPEP § 2123.

Applicants state that there is no motivation (nor does the Examiner point to any motivation) to use those broad ranges the Examiner recites from Table 1 of the '796 patent to achieve the specific compositions recited in Applicants' claim 1.

In response, when the reference relied on expressly anticipates or make obvious all of the elements of the claimed invention, the reference is presumed to be operable (MPEP § 2121 and § 2121.02).

Applicants state that Applicants have disclosed the unexpected superior results of the carefully crafted and claimed compositions.

In response, the discovery of a previously unappreciated property of a prior art composition, or of a scientific explanation for the prior art's functioning, does not render the old composition patentably new to the discoverer (MPEP § 2112(I)).

II. Claims **6-14** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 6-14 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 in combination with Reid '857 is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

III. Claims **15-18** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 15-18 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 in combination with Reid '857 is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

IV. Claims **19-25** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 19-25 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 in combination with Reid '857 is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

V. Claims **26-33** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 26-33 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 in combination with Reid '857 is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the following reasons:

Applicants state that the Examiner cannot rely on the broad range set forth in

Table 1 of the '796 patent in the face of the facts that there is (1) no motivation in the '796 patent to reach the previously avoided relative ratios as currently claimed by Applicants (which presently claimed composition ratios achieve unexpected superior results as discussed above) and, (2) the '796 patent actually teaches away from such ratios by asserting that the low copper high acid ratio of 0.1 is an important aspect of the disclosed alleged invention.

In response, (1) when the reference relied on expressly anticipates or make obvious all of the elements of the claimed invention, the reference is presumed to be operable (MPEP § 2121 and § 2121.02), and (2) disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments (MPEP § 2123).

VI. Claim 34 has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796].

The rejection of claim 34 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

VII. Claims **35-43** have been rejected under 35 U.S.C. 103(a) as being unpatentable

over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 35-43 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 in combination with Reid '857 is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the following reasons:

Applicants state that the Examiner cannot rely on the broad range set forth in Table 1 of the '796 patent in the face of the facts that there is (1) no motivation in the '796 patent to reach the previously avoided copper and acid concentration as currently claimed by Applicants, and (2) the '796 patent actually teaches away from such ratios by asserting that the high acid concentration (180 g/L) is an important aspect of the disclosed alleged invention.

In response, (1) when the reference relied on expressly anticipates or make obvious all of the elements of the claimed invention, the reference is presumed to be operable (MPEP § 2121 and § 2121.02), and (2) disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments (MPEP § 2123).

VIII. Claims **44-52** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 44-52 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 in combination with Reid '857 is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

IX. Claims **53 and 54** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US Patent No. 6,024,857) ['857].

The rejection of claims 53 and 54 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 in combination with Reid '857 is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

X. Claims **55-56, 58, 60 and 62** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Uzoh et al.** (US Patent Application Publication No. 2002/0033342 A1).

The rejection of claims 55-56, 58, 60 and 62 under 35 U.S.C. 103(a) as being

unpatentable over Reid '796 in combination with Uzoh et al. has been is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

XI. Claims **57, 59 and 61** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Uzoh et al.** (US Patent Application Publication No. 2002/0033342 A1) as applied to claims 55-56, 58, 60 and 62 above, and further in view of **Basol** (US Patent No. 6,833,063 B2).

The rejection of claims 57, 59 and 61 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 in combination with Uzoh et al. as applied to claims 55-56, 58, 60 and 62 above, and further in view of Basol is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

XII. Claims **63-65** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Reid** (US

Patent No. 6,024,857) ['857].

The rejection of claims 63-65 under 35 U.S.C. 103(a) as being unpatentable over Reid et al. '796 in combination with Reid '857 is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

XIII. Claims **66 and 67** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

The rejection of claims 66 and 67 under 35 U.S.C. 103(a) as being unpatentable over Reid'796 in combination with Wilson et al. is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

XIV. Claims **68 and 69** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Reid et al.** (US Patent No. 6,793,796 B2) ['796] in combination with **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

The rejection of claims 68 and 69 under 35 U.S.C. 103(a) as being unpatentable over Reid '796 in combination with Wilson et al. is as applied in the Office Action dated November 23, 2005 and incorporated herein. The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

Response to Amendment

Claim Rejections - 35 USC § 112

I. Claims **55-62** are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for electrodepositing, does not reasonably provide enablement for electrolessly depositing. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

Claim 55

line 4, recites "depositing copper".

Applicants' specification discloses electroplating methods (page 5, line 11). However, claim 55, as presently written, reads on electrolessly depositing the copper. Thus, the claims are not commensurate in scope with the specification.

II. Claims **34, 62 and 68-69** are rejected under 35 U.S.C. 112, second paragraph,

as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 34

lines 6-7, the composition already comprises an aqueous-based mixture of copper and sulfuric acid wherein the ratio in g/L solution of copper to acid is equal to about 0.3 to about 0.8 (from claim 34, lines 2-3). However, it is unclear if the composition further comprises an additional mixture of copper and sulfuric acid wherein the ratio in g/L solution of copper to acid is equal to about 0.3 to about 0.8 because, then, the electroplating composition would contain two mixtures – the mixture and the aqueous-based mixture (from claim 34, lines 2-3).

Claim 34, lines 6-7, as presently written, reads on that the mixture of copper and sulfuric acid wherein the ratio in g/L solution of copper to acid is equal to about 0.3 to about 0.8 is not the same as the aqueous-based mixture of copper and sulfuric acid wherein the ratio in g/L solution of copper to acid is equal to about 0.3 to about 0.8 recited in claim 34, lines 2-3.

Claim 62

line 3, recites “from about 2 to about 30 ml/L of a copper-deposition suppressor”.

The composition already comprises a glycol-based suppressor (from claim 55, line 6). However, it is unclear if the composition further comprises an additional from

about 2 to about 30 ml/L of a copper-deposition suppressor because, then, the electroplating composition would contain two suppressors.

Claim 62, line 3, as presently written, reads on that the copper-deposition suppressor is not the same as the glycol-based suppressor recited in claim 55, line 6.

Claim 68

line 9, “during repair of the seed layer” lacks antecedent basis.

Claim 69

lines 2-3, the composition already comprises a mixture of copper and sulfuric acid wherein the ratio in g/L solution of copper to acid is equal to about 0.3 to about 0.8 (from claim 68, lines 13-15). However, it is unclear if the composition further comprises an additional mixture of copper and sulfuric acid wherein the ratio in g/L solution of copper to acid is equal to about 0.3 to about 0.8 because, then, the electroplating composition would contain two mixtures – the mixture recited in claim 69 and the mixture recited in claim 68.

Claim 69, lines 2-3, as presently written, reads on that the mixture of copper and sulfuric acid wherein the ratio in g/L solution of copper to acid is equal to about 0.3 to about 0.8 is not the same as the mixture of copper and sulfuric acid wherein the ratio in g/L solution of copper to acid is equal to about 0.3 to about 0.8 recited in claim 68, lines 13-15.

III. Claims **63-65** are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential steps, such omission amounting to a gap between the steps. See MPEP § 2172.01. The omitted steps are: the electrolytically plating step.

Claim 63

lines 4-7, recites “depositing copper”.

The preamble of claim 63, line 1, as current amended, now recites “A method for electrolytically plating a workpiece”. The body of the claim, however, does not recite any electrolytically plating step. Thus, the body of the claim is inconsistent with its preamble.

Claim Rejections - 35 USC § 103

Composition

I. Claims **1-5** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an aqueous-based electroplating composition comprising:

(a) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(c) a glycol-based suppressor (= two-element polyethylene glycol based

suppressors) [page 2, [0020]].

The glycol-based suppressor is present at a concentration of from about 2 to about 30 ml/L (= between about 2 ml/l and about 15 ml/l) [page 3, claim 1].

The composition further comprises a copper-deposition accelerator (page 2, [0020]) present at a concentration of from about 2 to about 30 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 3, claim 1].

The composition further comprises from about 10 to about 100 ppm halide ion (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition further comprises from about 30 to about 60 ppm halide ion (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose wherein the chloride ions are from HCl, as recited in claim 5.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from HCl because HCl is a conventional source of chloride

ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

II. Claims **6-14** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an electroplating composition comprising:

(a) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(c) about 2 to about 30 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1];

wherein the balance of the composition is water.

The composition further comprises a copper-deposition accelerator (page 2, [0020]) present at a concentration of from about 2 to about 30 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 3, claim 1].

The copper-deposition suppressor is a random or block copolymer (= random/block copolymers of ethylene oxide and propylene oxide mixed in a wide range of ratios) [page 2, [0020]].

The copper-deposition suppressor is glycol-based (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The copper-deposition suppressor is a copper bath viaform suppressor (page 2, [0020]).

The composition further comprises from about 10 to about 100 ppm halide ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. Wherein the copper-deposition accelerator is SPS, as recited in claim 13.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising a brightener including bisulfopropyl disulfide (page 4, [0038]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the accelerator described by Grandikota with wherein the copper-deposition accelerator is SPS because Grandikota teaches that the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate (page 2, [0020]). A di-sulfate would have been SPS because SPS is a conventional accelerator used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0038]; and page 3, [0022]).

b. Wherein the chloride ions are from HCl, as recited in claim 14.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from HCl because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

III. Claims 15-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an aqueous electroplating composition comprising:

(a) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1];

(c) about 2 to about 30 ml/L of a copper-deposition accelerator (= between

about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1];

(d) about 2 to about 30 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1]; and

(e) about 40 to about 60 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The copper-deposition suppressor is glycol-based (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The copper-deposition accelerator is a sulphur containing compound (= the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate) [page 2, [0020]].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose the following:

a. Wherein the chloride ions are from hydrogen chloride, as recited in claim 15.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating

copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

b. Wherein the composition further comprises about 50 ppm HCl, as recited in claim 18.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the HCl described by Grandikota and Gabe with wherein the hydrogen chloride concentration is about 50 ppm HCl because where the claimed range overlaps or lies inside ranges disclosed by the prior art, a *prima facie* case of obviousness exists (MPEP § 2144.05).

IV. Claims 19-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an electroplating composition comprising:

(a) about 45 to about 55 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 4 g/l to about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1);

(c) a copper-deposition suppressor (page 2, [0020]); and

(d) a copper-deposition accelerator (page 2, [0020]).

The copper-deposition suppressor is at a concentration of from about 2 to about 10 ml/L (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The composition further comprises a copper-deposition accelerator present at a concentration of from about 2 to about 8 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is a sulphur containing compound (= the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate) [page 2, [0020]].

The composition further comprises from about 10 to about 100 ppm halide ion (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition further comprises from about 30 to about 60 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. About 75 to about 120 g/L sulfuric acid, as recited in claim 19.

Grandikota teaches between about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the sulfuric acid concentration described by Grandikota to about 75 g/l because a *prima facie* case of obviousness exist where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties (MPEP § 2144.05).

b. Wherein the chloride ions are from HCl, as recited in claim 23.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

c. Wherein the composition further comprises a leveler, as recited in claim 25.

Gabe teaches an aqueous-based electroplating composition comprising a leveler (page 4, [0039]).

It would have been obvious to one having ordinary skill in the art at the time the

invention was made to have modified the composition described by Grandikota with wherein the composition further comprises a leveler because levelers are conventional additives used in copper electroplating compositions for electroplating a level copper deposit onto integrated circuits and semiconductors as taught by Gabe (page 4, [0039]; and page 3, [0022]).

V. Claims **26-33** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an electroplating composition comprising:

(a) an aqueous mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.4 to about 0.8 ([= between about 30 g/l and about 55 g/l of copper sulfate] (page 2, [0018], esp., lines 1-4; and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1));

(b) a copper-deposition suppressor (page 2, [0020]); and

(c) a copper-deposition accelerator (page 2, [0020]).

The copper-deposition suppressor is a random or block copolymer (= random/block copolymers of ethylene oxide and propylene oxide mixed in a wide range of ratios) [page 2, [0020]].

The copper-deposition suppressor is a copper bath viaform suppressor (page 2,

[0020]).

The copper-deposition suppressor is glycol-based (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The composition further comprises a copper-deposition accelerator present in a concentration of from about 2 to about 30 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1];

The copper-deposition accelerator is a copper bath viaform accelerator (page 2, [0020]).

The composition further comprises from about 10 to about 100 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. Wherein the copper-deposition accelerator is SPS, as recited in claim 32.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising a brightener including bisulfopropyl disulfide (page 4, [0038]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the accelerator described by Grandikota with wherein the copper-deposition accelerator is SPS because Grandikota teaches that the accelerators used in the plating solution include sulfur containing compounds, such as

sulfite or di-sulfate (page 2, [0020]). A di-sulfate would have been SPS because SPS is a conventional accelerator used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0038]; and page 3, [0022]).

b. Wherein the chloride ions are from HCl, as recited in claim 33.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

VI. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1).

Grandikota teaches an electroplating composition comprising:

(a) an aqueous mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.3 to about 0.8 (= between about 30 g/l and about 55 g/l of copper sulfate] (page 2, [0018], esp., lines 1-4; and

page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1));

(b) a copper-deposition suppressor (page 2, [0020]); and

(c) a copper-deposition accelerator (page 2, [0020]);

wherein only electroplating compositions comprising a mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.4 to about 0.8 are used to deposit copper on a workpiece.

VII. Claims **35-43** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an electroplating composition comprising:

(a) an aqueous mixture of copper and sulfuric acid wherein the copper concentration in the composition is within about 60% to about 90% of its solubility limit (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1] when the sulfuric acid concentration is from about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1];

(b) a copper-deposition suppressor (page 2, [0020]); and

(c) a copper-deposition accelerator (page 2, [0020]).

The copper-deposition suppressor is present at a concentration of from about 2 to about 30 ml/L (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is present at a concentration of from about 2 to about 30 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1].

The composition further comprises from about 10 to about 100 ppm halide ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition further comprises from about 30 to about 60 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The copper-deposition suppressor is present at a concentration of from about 2 to about 10 ml/L (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is present at a concentration of from about 2 to about 8 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is a sulphur containing compound (= the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate) [page 2, [0020]].

The copper-deposition suppressor is glycol-based (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose wherein the chloride ions are from HCl, as recited in claim 39.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

VIII. Claims **44-52** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an electroplating composition comprising:

(a) about 40 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1);

(c) a copper-deposition suppressor (page 2, [0020]); and

(d) a copper-deposition accelerator (page 2, [0020]).

The copper-deposition suppressor is present at a concentration of from about 2 to about 30 ml/L (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is present at a concentration of from about 2 to about 30 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1].

The composition further comprises from about 10 to about 100 ppm halide ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition further comprises from about 30 to about 60 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The copper-deposition suppressor is present at a concentration of from about 2 to about 10 ml/L (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The copper-deposition accelerator is present at a concentration of from about 2 to about 8 ml/L (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3,

claim 1].

The copper-deposition accelerator is a sulphur containing compound (= the accelerators used in the plating solution include sulfur containing compounds, such as sulfite or di-sulfate) [page 2, [0020]].

The copper-deposition suppressor is glycol-based (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. About 100 g/L sulfuric acid, as recited in claim 44.

Grandikota teaches about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the sulfuric acid concentration described by Grandikota to about 100 g/l because a *prima facie* case of obviousness exist where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties (MPEP § 2144.05).

- b. Wherein the chloride ions are from HCl, as recited in claim 49.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

IX. Claims **53 and 54** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches an aqueous electroplating composition comprising:

(a) about 50 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(b) about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1);

(c) about 2 to about 10 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1]; and

(d) about 2 to about 8 ml/L of a copper-deposition accelerator (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1];

The composition further comprises from about 10 to about 100 ppm halide ion (= 20-200 mg/l chloride ions) [col. 7, Table 1].

The composition further comprises from about 10 to about 100 ppm halide ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The composition of Grandikota differs from the instant invention because Grandikota does not disclose about 80 g/L sulfuric acid, as recited in claim 53.

Grandikota teaches about 4 g/l and about 60 g/l sulfuric acid (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the sulfuric acid concentration described by Grandikota to about 80 g/l because a *prima facie* case of obviousness exist where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties (MPEP § 2144.05).

Method

X. Claims **55-62** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination **Basol** (US Patent No. 6,833,063 B2) and **Uzoh et al.** (US Patent Application Publication No. 2002/0033342 A1).

Grandikota teaches a method for plating a workpiece comprising:

(a) providing a workpiece having a plurality of device features (= a substrate with

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a patterned dielectric layer of Si/SiO₂ thereon) including a seed layer (= a PVD Cu seed layer) wherein the plurality of device features is to be metallized (page 3, [0021]);

(b) depositing copper within the plurality of device features (= activity inside features so as to achieve bottom up growth) [page 3, [0020], esp., lines 24-25] utilizing an electroplating composition comprising:

(i) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(ii) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(iii) a glycol-based suppressor (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The method further comprises a seed enhancement procedure (= a PVD Cu seed layer) [page 3, [0021]].

The electroplating composition comprises:

(i) from about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(ii) from about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(iii) from about 2 to about 30 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The method of Grandikota differs from the instant invention because Grandikota does not disclose the following:

- a. Rinsing and drying the workpiece, wherein the rinsing and/or the drying occurs in a chamber in which the deposition of copper is performed, as recited in claim 57.
- b. Selective etching of copper deposited on the workpiece, as recited in claim 58.
- c. Cleaning the backside of the workpiece after copper is deposited on the workpiece, as recited in claim 59.
- d. Precleaning the workpiece prior to depositing copper wherein the precleaning of the workpiece is performed in a plating tool in which plating tool the deposition is also performed, as recited in claim 61.

Like Grandikota, Basol teaches a method for plating a workpiece. Basol teaches a system that allows for edge conductor removal, workpiece front surface cleaning, or both to be performed in the same processing chamber that is used for deposition or removal processing of the workpiece (col. 3, lines 61-65; and col. 14, claim 7). This allows for more efficient processing, including the removal of edge copper from a front face of the wafer, and removal of edge copper as part of other cleaning processes (col.

3, lines 34-38).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Grandikota by rinsing and drying the workpiece, wherein the rinsing and/or the drying occurs in a chamber in which the deposition of copper is performed; cleaning the backside of the workpiece after copper is deposited on the workpiece; and precleaning precleaning the workpiece prior to depositing copper wherein the precleaning of the workpiece is performed in a plating tool in which plating tool the deposition is also performed because this would have allowed for more efficient processing, including the removal of edge copper from a front face of the wafer, and removal of edge copper as part of other cleaning processes as taught by Basol (col. 3, lines 34-38).

e. Annealing the workpiece at temperatures below about 100°C, as recited in claim 60.

Like Grandikota, Uzoh teaches a method for plating a workpiece. Uzoh teaches that for optimum interconnect performance, it is highly desirable to stabilize the structure by annealing the deposited copper. The annealing temperature may range from 60°C in an inert ambient such as nitrogen or in a reducing ambient, or even in a vacuum chamber (page 6, [0073]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Grandikota by annealing

the workpiece at temperatures below about 100°C because the structure would have been stabilized by annealing the deposited copper as taught by Uzoh (page 6, [0073]).

XI. Claims **63-65** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Gabe et al.** (US Patent Application Publication No. 2003/0066756 A1).

Grandikota teaches a method for plating a workpiece comprising:

(a) providing a workpiece having a plurality of device features (= a substrate with a patterned dielectric layer of Si/SiO₂ thereon) including a seed layer (= a PVD Cu seed layer) wherein the plurality of device features is to be metallized (page 3, [0021]);

(b) depositing copper within the plurality of device features (= activity inside features so as to achieve bottom up growth) [page 3, [0020], esp., lines 24-25] utilizing an electroplating composition comprising:

(i) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(ii) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1];

(iii) about 2 to about 30 ml/L of a copper-deposition accelerator (= between about 1.5 ml/l and about 8 ml/l) [page 2, [0020]; and page 3, claim 1];

(iii) about 2 to about 30 ml/L of a copper-deposition suppressor (=

between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1];
and

(iv) about 40 to about 60 ppm chloride ions (= between about 10 ppm and about 80 ppm of chloride ions) [page 2, [0020], esp., lines 1-3].

The electroplating composition comprises a mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.4 to about 0.8 ([= between about 30 g/l and about 55 g/l of copper sulfate] (page 2, [0018], esp., lines 1-4; and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1)), a copper-deposition suppressor (page 2, [0020]), and a copper-deposition accelerator (page 2, [0020]).

The electroplating composition comprises a mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.3 to about 0.8 ([= between about 30 g/l and about 55 g/l of copper sulfate] (page 2, [0018], esp., lines 1-4; and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1)), a copper-deposition suppressor (page 2, [0020]), and a copper-deposition accelerator (page 2, [0020]) and wherein only electroplating compositions comprising a mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.3 to about 0.8 are used to deposit copper on the workpiece.

The method of Grandikota differs from the instant invention because Grandikota

does not disclose wherein the chloride ions are from hydrogen chloride, as recited in claim 63.

Like Grandikota, Gabe teaches an aqueous-based electroplating composition comprising chloride ions from HCl (page 4, [0045]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the chloride ions described by Grandikota with wherein the chloride ions are from hydrogen chloride because HCl is a conventional source of chloride ions used in copper electroplating compositions for electroplating copper onto integrated circuits and semiconductors as taught by Gabe (page 4, [0045]; and page 3, [0022]).

XII. Claims **66 and 67** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in combination with **Reid et al.** (US Patent No. 6,793,796 B2) and **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

Grandikota teaches a process for applying a metallization interconnect structure, comprising:

(a) providing a workpiece on which a metal seed layer been formed using a first deposition process (= a PVD Cu seed layer) [page 3, [0021]];

(b) electrolytically depositing a metal on the seed layer utilizing an electroplating composition comprising:

(i) about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(ii) about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(iii) a glycol-based suppressor (= two-element polyethylene glycol based suppressors) [page 2, [0020]].

The electroplating composition comprises:

(i) from about 35 to about 60 g/L copper (= between about 30 g/l and about 55 g/l of copper sulfate) [page 2, [0018], esp., lines 1-4; and page 3, claim 1];

(ii) from about 65 to about 150 g/L sulfuric acid (= between about 4 g/l and about 60 g/l sulfuric acid) [page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1]; and

(iii) from about 2 to about 30 ml/L of a copper-deposition suppressor (= between about 2 ml/l and about 15 ml/l) [page 2, [0020]; and page 3, claim 1].

The method of Grandikota differs from the instant invention because Grandikota does not disclose enhancing the seed layer by electrochemically depositing additional metal on the seed layer within a principal fluid chamber of a reactor to provide an enhanced seed layer using a deposition process comprising supplying electroplating

power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece, as recited in claim 66.

Like Grandikota, Reid teaches a process for applying a metallization interconnect structure. Reid teaches that a seed layer, typically deposited by a PVD or CVD process may be non-uniform and may exhibit islands, that is the seed layer may not completely cover the surface of all the features of the wafer (col. 3, lines 39-43). An initiation phase is done to nucleate and grow a relatively thin, typically less than 500 Å thick, conformal film onto the seed layer. The conformal film should fill recesses between islands of an initially discontinuous seed layer with metal such that the entire structure becomes a single continuous, conducting metal layer without abnormal grain boundaries (col. 5, lines 45 to col. 6, line 16).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the PVD Cu seed layer described by Grandikota by enhancing the seed layer by electrochemically depositing additional metal on the seed layer within a principal fluid chamber of a reactor to provide an enhanced seed layer using a deposition process comprising supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece because this would have filled recesses between islands of an initially discontinuous seed layer with metal such that the entire structure becomes a single continuous, conducting metal layer without abnormal grain boundaries as taught by Reid (col. 5, lines 45 to col. 6, line 16).

As to supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece, like Grandikota and Reid, Wilson teaches a process for applying a metallization interconnect structure. Wilson teaches that the current is applied by a plurality of electrodes in a manner that can account for different plating characteristics at different portions of the workpiece, and the current applied to individual electrodes is changed to account for changes in behavior as thickness of the conductive material on the workpiece increases. As a result, conductive material such as copper are deposited on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties (page 2, [0010] and [0011]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Grandikota and Reid by using a deposition process comprising supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece because this would have resulted in depositing a conductive material such as copper on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties as taught by Wilson (page 2, [0010] and [0011]).

XIII. Claims **68 and 69** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Grandikota et al.** (US Patent Application Publication No. 2002/0112964 A1) in

combination with **Reid et al.** (US Patent No. 6,793,796 B2) and **Wilson et al.** (US Patent Application Publication No. 2005/0178667 A1).

Grandikota teaches a process for applying a metallization interconnect structure, comprising:

(a) providing a workpiece on which a metal seed layer been formed (= a PVD Cu seed layer) [page 3, [0021]];

(b) electrolytically depositing copper on the seed layer under conditions in which the deposition rate of the electrolytic deposition process is substantially greater than the deposition rate of the process used to enhance the seed layer utilizing an electroplating composition comprising:

(a) an aqueous mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.4 to about 0.8 ([= between about 30 g/l and about 55 g/l of copper sulfate] (page 2, [0018], esp., lines 1-4; and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1, [0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1));

(b) a copper-deposition suppressor (page 2, [0020]); and

(c) a copper-deposition accelerator (page 2, [0020]).

The electroplating composition comprises a mixture of copper and sulfuric acid wherein the ratio in g/L of solution of copper to acid is equal to about 0.3 to about 0.8 ([= between about 30 g/l and about 55 g/l of copper sulfate] (page 2, [0018], esp., lines 1-4; and page 3, claim 1); and [between about 4 g/l to about 60 g/l sulfuric acid] (page 1,

[0007]; page 2, [0016], esp., lines 7-8; and page 3, claim 1)).

The method of Grandikota differs from the instant invention because Grandikota does not disclose the following:

a. Enhancing the seed layer by electrochemically depositing additional metal on the seed layer within a principal fluid chamber of a reactor to provide an enhanced seed layer using a deposition process comprising supplying electroplating power to a plurality electrodes within the principal fluid flow chamber, as recited in claim 68.

Like Grandikota, Reid teaches a process for applying a metallization interconnect structure. Reid teaches that a seed layer, typically deposited by a PVD or CVD process may be non-uniform and may exhibit islands, that is the seed layer may not completely cover the surface of all the features of the wafer (col. 3, lines 39-43). An initiation phase is done to nucleate and grow a relatively thin, typically less than 500 Å thick, conformal film onto the seed layer. The conformal film should fill recesses between islands of an initially discontinuous seed layer with metal such that the entire structure becomes a single continuous, conducting metal layer without abnormal grain boundaries (col. 5, lines 45 to col. 6, line 16).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the PVD Cu seed layer described by Grandikota by enhancing the seed layer by electrochemically depositing additional metal on the seed layer within a principal fluid chamber of a reactor to provide an enhanced seed

layer using a deposition process comprising supplying electroplating power to a plurality electrodes within the principal fluid flow chamber because this would have filled recesses between islands of an initially discontinuous seed layer with metal such that the entire structure becomes a single continuous, conducting metal layer without abnormal grain boundaries as taught by Reid (col. 5, lines 45 to col. 6, line 16).

As to supplying electroplating power to a plurality of anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece, like Grandikota and Reid, Wilson teaches a process for applying a metallization interconnect structure. Wilson teaches that the current is applied by a plurality of electrodes in a manner that can account for different plating characteristics at different portions of the workpiece, and the current applied to individual electrodes is changed to account for changes in behavior as thickness of the conductive material on the workpiece increases. As a result, conductive material such as copper are deposited on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties (page 2, [0010] and [0011]).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Grandikota and Reid by using a deposition process comprising supplying electroplating power to a plurality of concentric anodes disposed at different positions within the principal fluid flow chamber relative to the workpiece because this would have resulted in depositing a conductive

material such as copper on the workpiece at a uniform current density or other desired current density to provide a conductive layer having the desired properties as taught by Wilson (page 2, [0010] and [0011]).

b. Independently controlling the supply of electrical power to the at least two electrodes during repair of the seed layer; as recited in claim 68.

Wilson also teaches independently controlling the supply of electrical power to the at least two electrodes during repair of the seed layer (page 11, [0092]).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

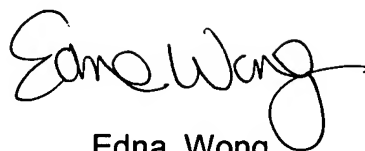
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic

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Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read "Edna Wong". The signature is fluid and cursive, with the first name "Edna" and last name "Wong" clearly distinguishable.

Edna Wong
Primary Examiner
Art Unit 1753

EW
March 4, 2006